

Claims

1. A method for removing a nitrogen oxide (NO_x) from a gas by bringing the gas into contact with a scrub liquid in a scrubber for converting the nitrogen oxide into molecular nitrogen (N_2), wherein the scrub liquid comprises a metal ion chelate and a biomass, after which at least a portion of the scrub liquid is subjected to a membrane separation process for separating at least part of the metal ion chelate, and the biomass and other solidified components, from dissolved components, wherein the membrane separation process comprises:
 - a) filtering at least a portion of the scrub liquid using a first membrane capable of permeating the metal ion chelate to provide a first retentate liquid comprising the biomass and other solidified components, and a first permeate liquid comprising at least part of the metal ion chelate and dissolved components, and
 - b) nanofiltering the first permeate liquid to give a second retentate liquid comprising the metal ion chelate and a second permeate liquid comprising dissolved components, and
 - c) recycling at least part of the second retentate liquid to the scrubber.
2. The method according to claim 1 wherein the first membrane is a membrane capable of permeating compounds having a molecular weight of 1,000 Dalton.
3. The method according to claim 1 or 2 wherein the first membrane is an ultrafiltration membrane.
4. The method according to any one of claims 1-3 wherein the gas further comprises at least one of a sulfur oxide (SO_x), which is converted into at least one of a solidified sulfite or sulfate salt, and the scrub liquid further comprises an agent for binding with the sulfur oxide, and wherein solidified sulfite and/or sulfate salts are separated from the scrub liquid.

5. The method according to claim 4 wherein the first permeate is pre-treated before nanofiltering so as to prevent the solidification of compounds that are liable to cause scaling.
- 5 6. The method according to claim 5 wherein the first permeate is diluted with an amount of water which is at least equal to the amount of water that is removed by nanofiltering of the first permeate minus the amount of water that can be removed without precipitation of the inorganic compounds in the first permeate.
- 10 7. The method according to claim 4, 5 or 6 wherein the scrub liquid is pre-treated before filtering using the first membrane so as to prevent the solidification of compounds that are liable to cause scaling.
- 15 8. The method according to claim 7 wherein the scrub liquid is diluted with an amount of water which is at least equal to the amount of water that is removed by filtering of the scrub liquid minus the amount of water that can be removed without precipitation of the inorganic compounds in the scrub liquid.
- 20 9. The method according to any one of claims 1-8 wherein the gas further comprises heavy metals.
10. The method according to any one of claims 1-9 wherein the conversion of the nitrogen oxide into molecular nitrogen is brought about by the biomass.
- 25 11. The method according to any one of claims 1-10 wherein the agent for binding with the sulfur oxide comprises at least one of calcium and magnesium ions.
- 30 12. The method according to any one of claims 1-11 wherein the dissolved components of the permeate liquid comprise at least one of chloride and sulfate ions.

13. The method according to any one of claims 1-12 wherein the biomass comprises at least one of bacteria and yeast.

5 14. The method according to any one of claims 1-13 wherein the metal ion chelate comprises an aminopolycarboxylic acid, preferably ethylene diaminetetraacetic acid (EDTA) and a transition metal ion, preferably a ferrous ion.

10 15. The method according to any one of claims 1-14 wherein the ultrafiltration membrane is selected from polysulfone, polyethersulfone, polyvinylidene fluoride, polyacrylonitrile, or modified versions thereof, and the nanofiltration membrane is selected from asymmetric phase inversion membranes or thin film composite membranes.

15 16. The method according to any one of claims 1-15 wherein monovalent cations are added to the scrub liquid.

20 17. An apparatus for performing the method of any one of claims 1-16 comprising a scrubber (1) and a membrane separation unit (15,18), characterized in that the membrane separation unit (30,15,35,18) comprises, optionally, a first pretreatment module (30), a first filtration compartment (15) comprising a membrane capable of permeating the metal ion chelate, a second pretreatment module (35) and a second nanofiltration compartment (18), means (28) for transporting the retentate liquid obtained in the second nanofiltration compartment (18) to the scrubber (1) and/or means (16) for transporting the retentate liquid obtained in the first filtration compartment (15) to the scrubber (1).

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